FY15 RSM-EWN IPR

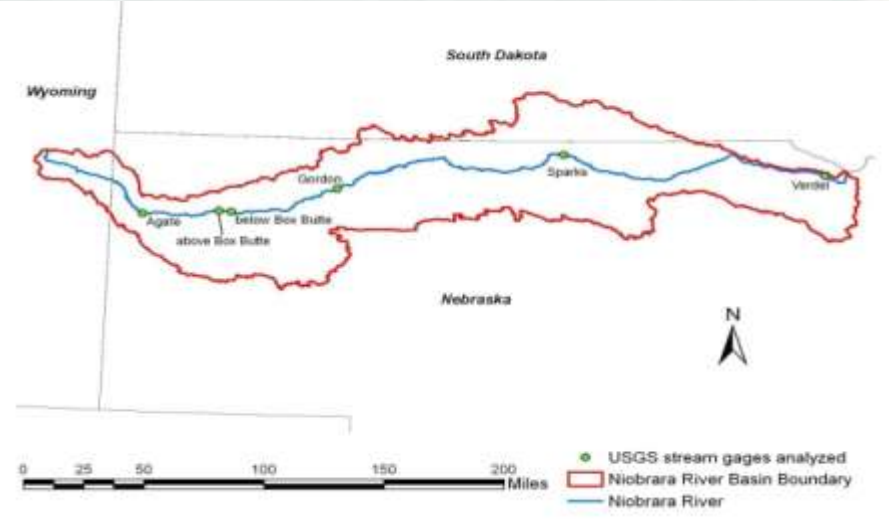
Omaha District: Monitoring Spencer Dam Flushing on the Niobrara River to Reduce Uncertainty in HEC-RAS Reservoir Flushing Modeling

Paul Boyd and Stanford Gibson

BLUF: Data collection before, during, and after a scheduled reservoir flush at Spencer Dam on the Niobrara River will allow validation testing of the HEC-RAS model software for reservoir management modeling. This will be the first validated reservoir flushing model developed in HEC-RAS and demonstrate and improve HEC-RAS capabilities for reservoir sediment management.

Problem Statement/Issue

- HEC-RAS is being used to develop reservoir management scenarios, including flushing and sluicing
- While the code appears functional and correct, it has not been tested with data from many actual flushes
- Without proof that the HEC-RAS model will accurately replicate a flushing event, confidence in the model's ability will remain low



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Approach to Address Problem

1. Collect data from a Spencer Dam flushing event (or two)
2. Build a HEC-RAS model to replicate the event
3. Use lessons learned to tweak HEC-RAS code (if necessary) and apply to other flushing models

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USACE RSM PDT

Paul Boyd, PE, CENWO-ED-HF, Omaha District RSM Program Manager
Stanford Gibson, CEIWR-HEC, Hydrologic Engineering Center, HEC-RAS Sediment Model
Dan Pridal, PE, CENWO-ED-HF, Chief, River and Reservoir Engineering, Omaha District
Ben Ream, CENWO-ED-HF, Hydraulic Engineer
Bill Williams, CENWO-ED-HF, Hydro Surveying Technician

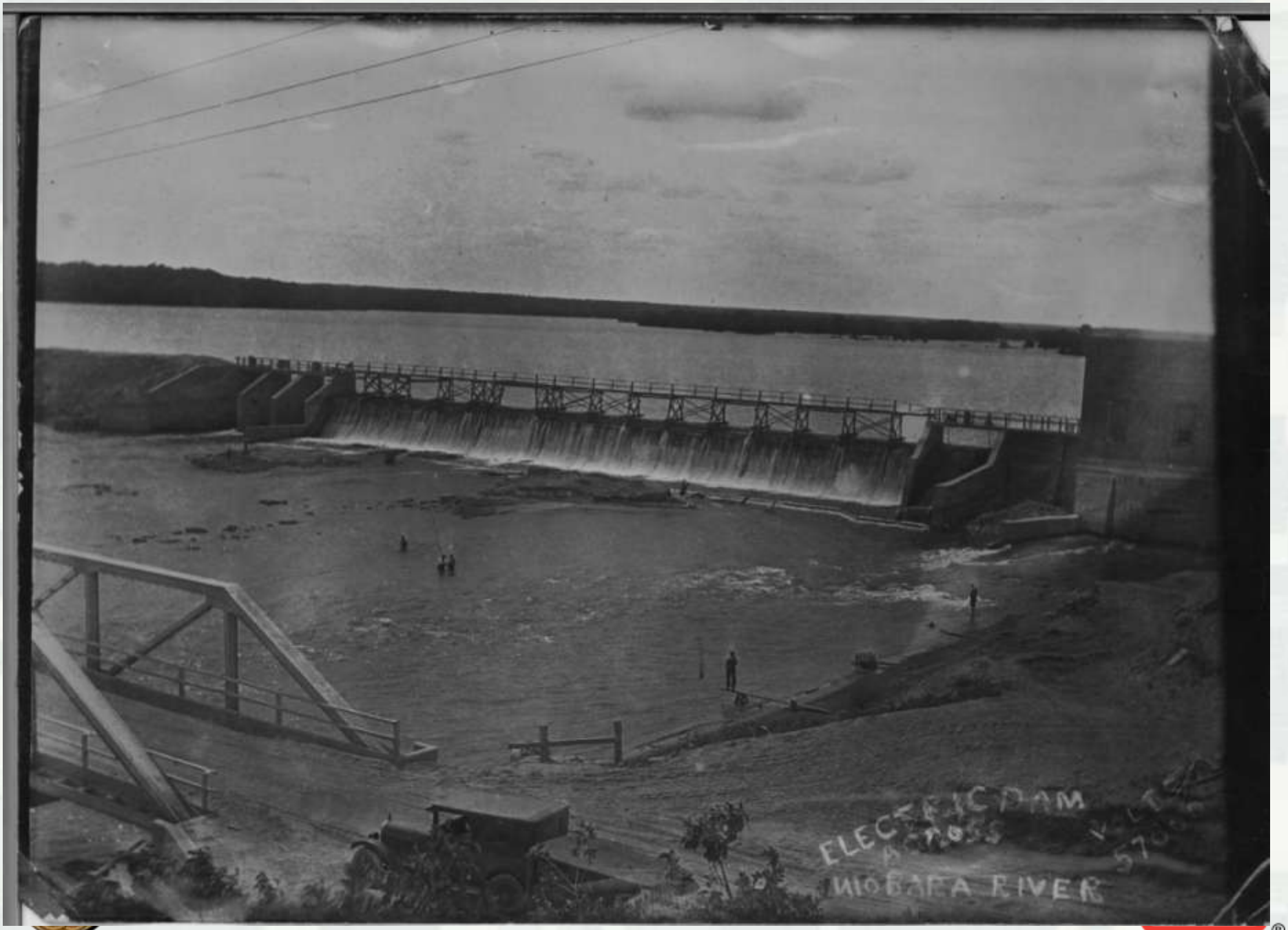
Stakeholders/Partners

Ron Zelt, Associate Director, USGS Nebraska Water Science Center
Brenda Woodward, USGS Nebraska Water Science Center
David Overhue, Nebraska Public Power District

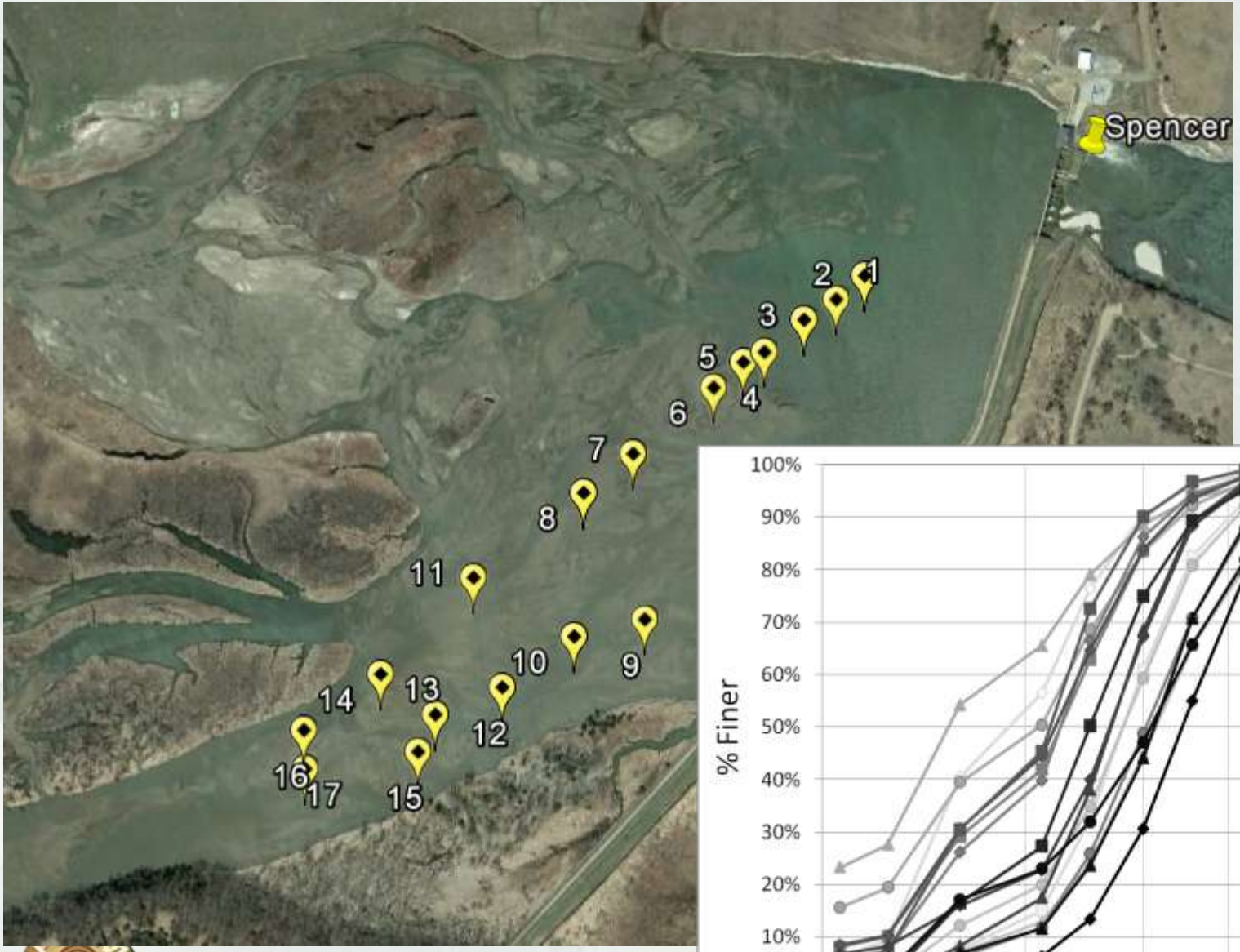
What key leveraging opportunity(s) did stakeholders/partners provide?

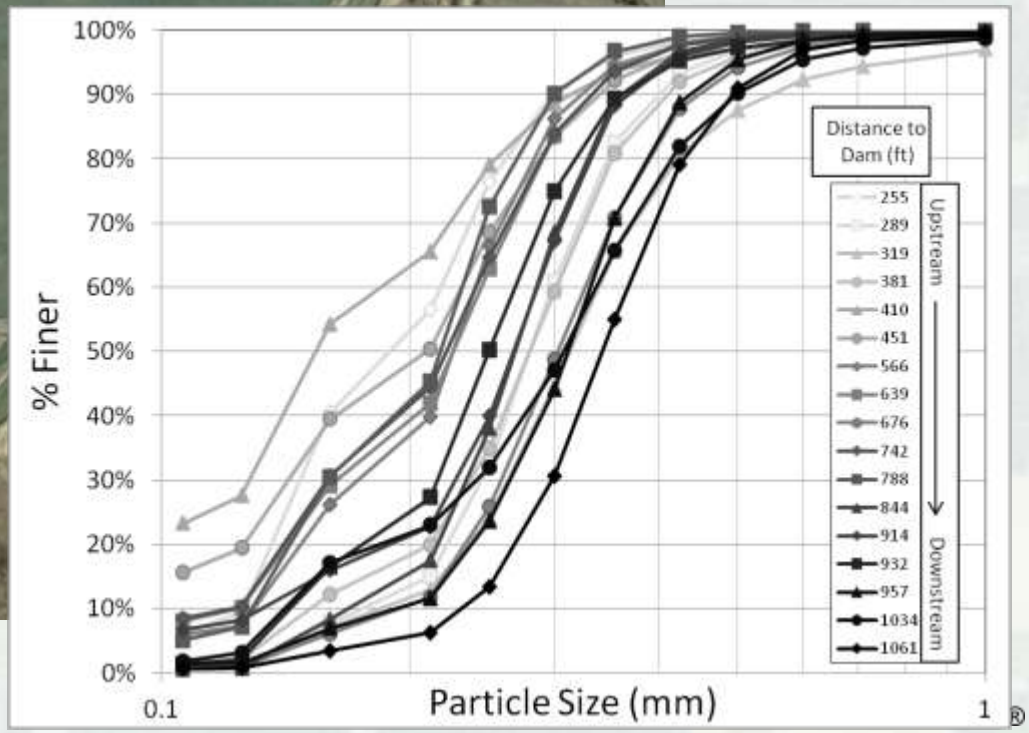
- This project will be a combined effort of 1) USACE Omaha District, 2) IWR-Hydrologic Engineering Center, 3) the Large Rivers Initiative at the US Geological Survey, 4) The Missouri River Recovery Program (MRRP) and 5) the RSM Program. **All five programs committed funding to the project.**

- Spencer Dam Facts
  - Built 1927
  - Owned by Nebraska Public Power District
  - 2 turbines, 1.9 MW combined capacity
  - 40 Miles from the mouth of the Niobrara
  - Same sediment that ends up in the Missouri River delta
  - Scheduled flush for past 60+ years
  - Currently monitored for DO changes and scheduled to avoid late spring spawning
  - Before flush, storage is 2-4% of original capacity
  - After flush (moves about 75-100 acre-feet), 6-10% of original capacity


ELECTRIC DAM
NIAGARA RIVER

Pre-Flush Sediment Samples

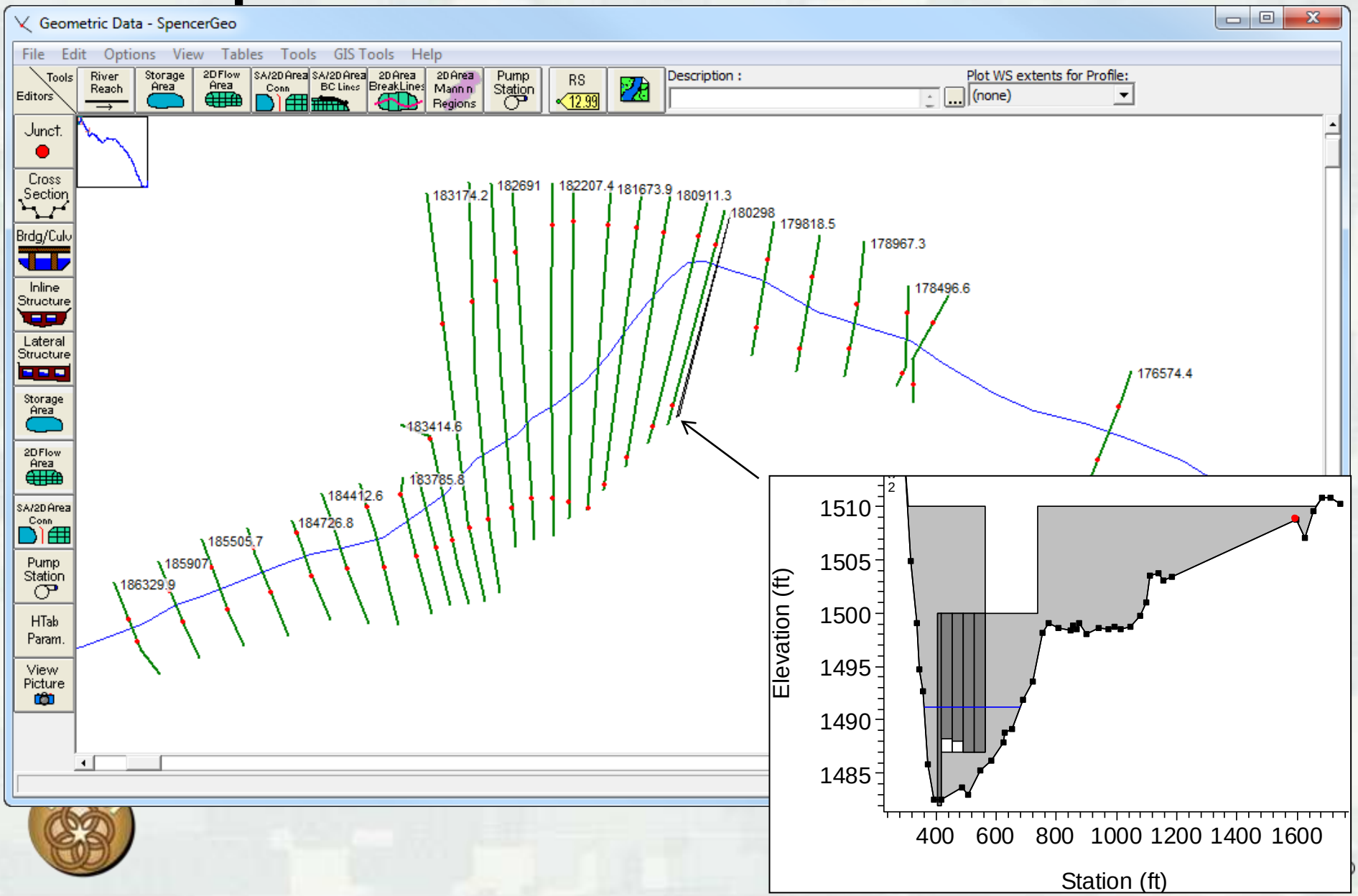




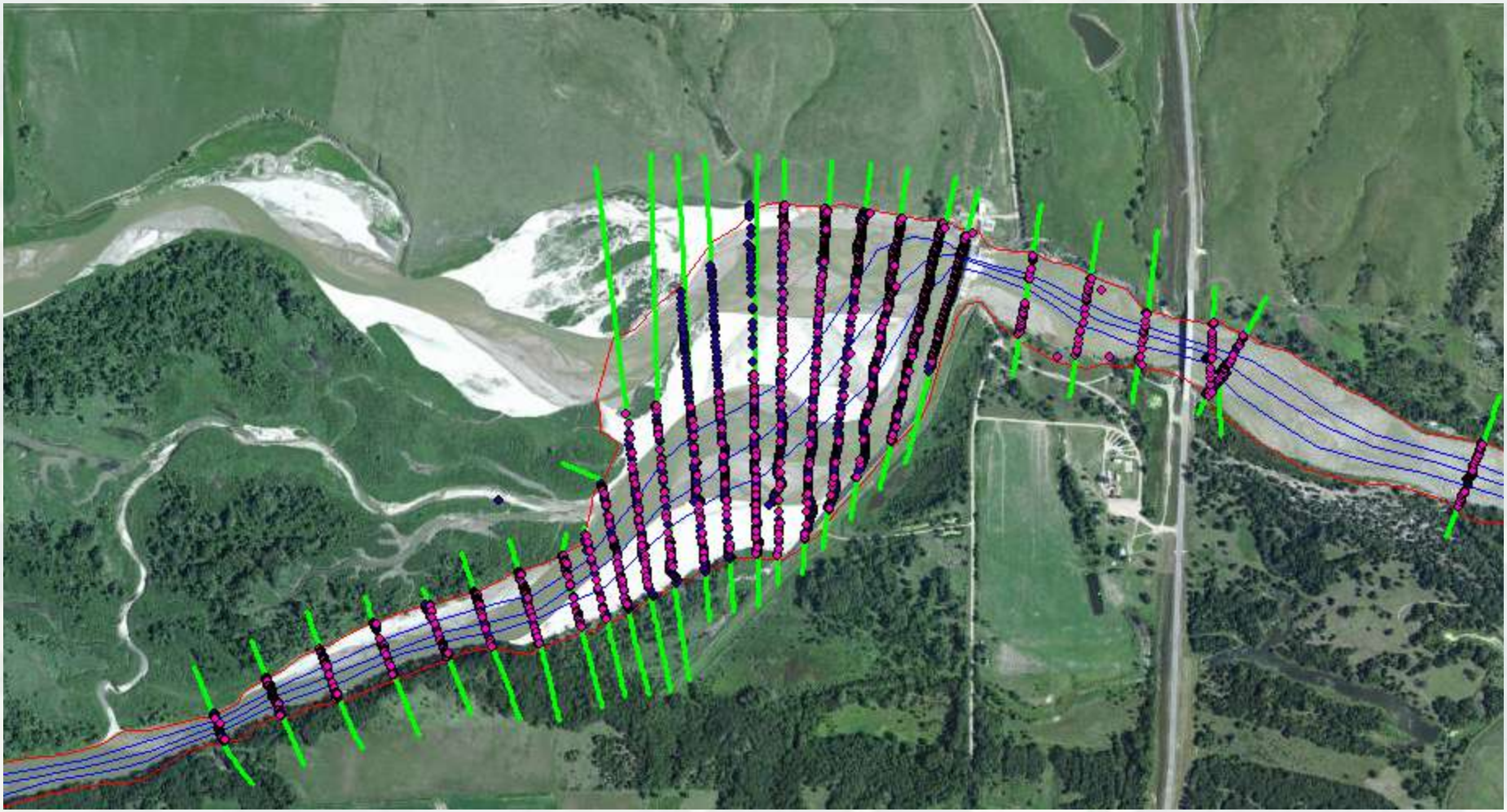
Upon Returning to Survey Post-Flush

Why do we live here?

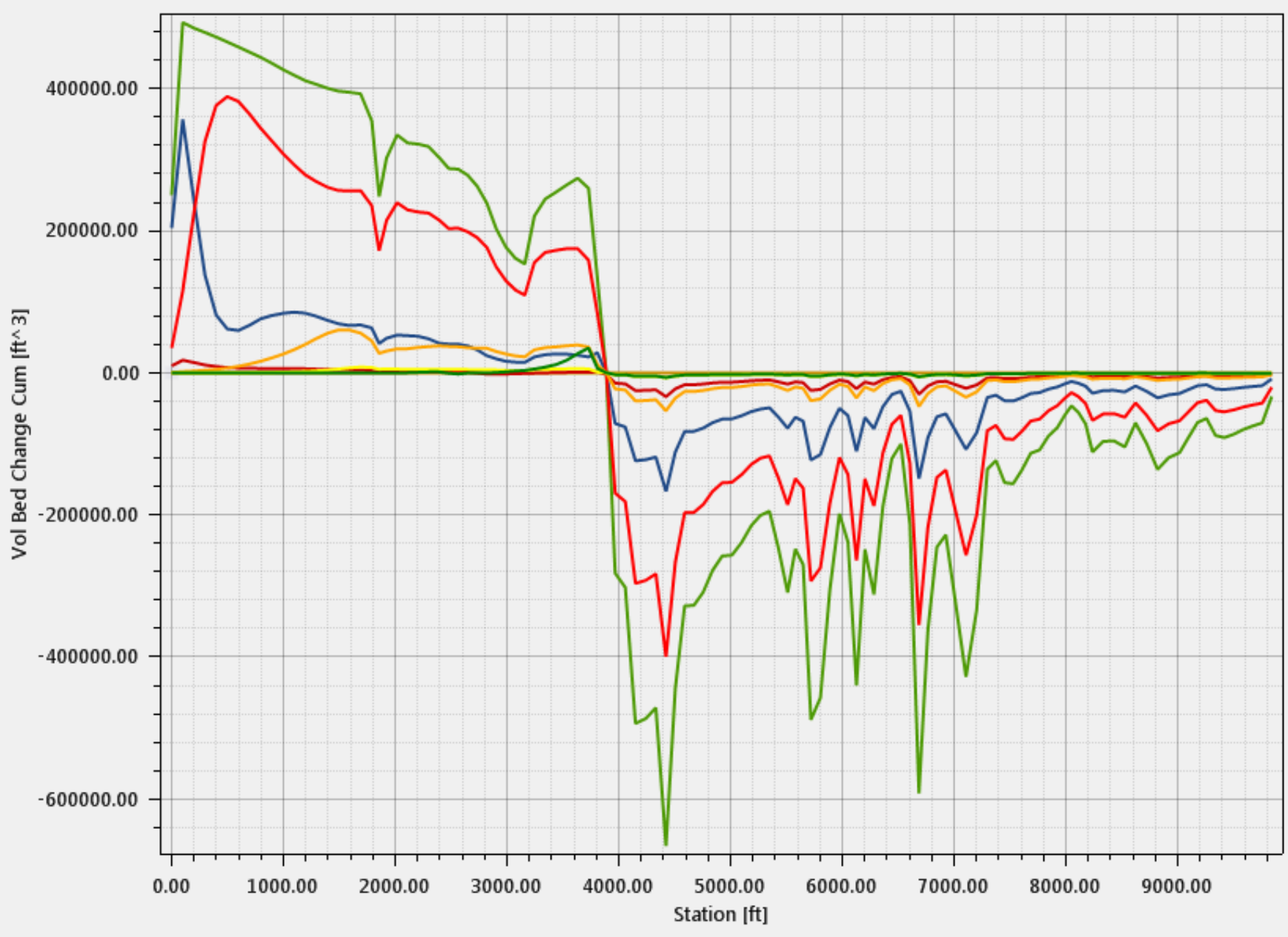
Spencer HEC-RAS Model



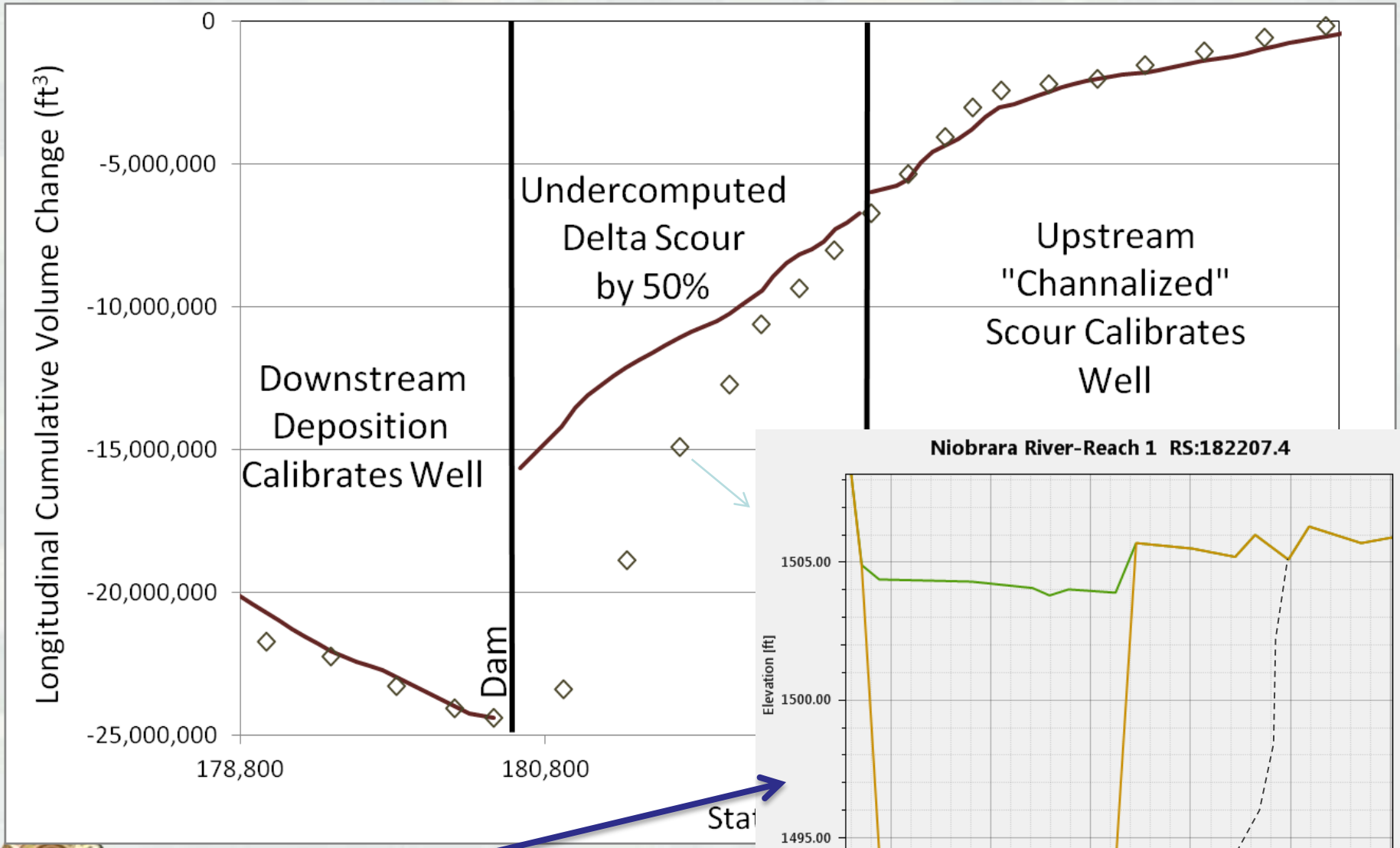
Spencer Dam HEC-RAS w/Sediment Model Geometry



Cumulative Volume Change (4 week run)



Spencer HEC-RAS Model



Will use BSTEM to address (RSM funded development in 2013 and 2014)

Products, Timeline, and Target

RiverFlow 2016 Abstract September 1

Submit ERDC Draft Tech Note September 30

Title: Guidelines for Simulating Reservoir Flushing with a 1D Sediment model

RiverFlow 2016 Paper February 1

Title : Monitoring and Modeling the Spencer Reservoir Sediment Flush

Future Activities:

-Integrate USGS data into Fall Calibration

-Model Spring Event

-Extend Model Downstream

-Try molding process with the Cantelli algorithm

Target Goal:

Integrate BSTEM into flushing model to capture lateral process

Submit Journal Paper to Regulated Rivers or ASCE Journal of Hydraulics

Title : Simulating reservoir flushing with coupled morphological and bank migration models.

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UPs – 3 Positives from effort

- Developed relationship with Nebraska Public Power District
- Results will allow HEC-RAS users to model reservoir flushes more accurately
- Large Benefit to other studies that propose flushing

DOWNs – 3 Negatives from effort

- NPPD still somewhat wary of what people think of their management technique (video not to be shown outside USACE)
- Freeze out in November 2014 required geometry estimates and a follow up survey collection for April 2015 flush
- Extreme flow change flushes require extremely short time step to run (resulting in long model runtimes)

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Value to the Nation: Most districts use HEC-RAS, as well as consultants and freelance engineers and students. This is an emerging model interest area, and hopefully this work will increase the use of HEC-RAS for reservoir modeling

1-D modeling is often less expensive than 2,3-D. If HEC-RAS can address questions that may have required more complex modeling efforts in the past, may be cost saving

Allows for continuous river/reservoir system modeling

It has started the discussion in other locations about the benefits of flushing (NWK and Kansas Water Board coming to see flush in September)

May serve as the foundation for a week long class in reservoir management as part of a river engineering certification

International Value: We will be using the HEC-RAS reservoir flushing tools with the Governments of Lao PDR and Vietnam through training and reservoir planning case studies over the next three years (USACE-USBR joint technical lead in support of USAID Smart Infrastructure for the Mekong River (SIM) Program